

DESCRIPTIONS AND KEYS TO THE FIRST-INSTAR NYMPHS OF
FIVE *PERIPLANETA* SPECIES (DICTYOPTERA: BLATTIDAE)

PEGGY K. POWELL AND WM. H. ROBINSON

Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

Abstract.—First-instar nymphs of *P. americana* (Linnaeus), *P. australasiae* (Fabricius), *P. brunnea* Burmeister, *P. fuliginosa* (Serville), and *P. japonica* Karny are described, and keys are given for their separation. All are common and widespread pests. These five species are divided into two groups based on characters of the first-instar nymphs. Group I includes *P. americana* and *P. japonica*, Group II includes *P. brunnea*, *P. fuliginosa*, and *P. australasiae*. Six types of setae are present: Long setae; moderately long setae; short setae; reclinate setae; chalazae; and small setae.

Adults of five *Periplaneta* species, *P. americana* (Linnaeus), *P. australasiae* (Fabricius), *P. brunnea* Burmeister, *P. fuliginosa* (Serville), and *P. japonica* Karny, are well known and have been studied with respect to their identification, biology, reproduction, and behavior. However, little research has been conducted on their immature stages. There are very few descriptions of the nymphs of any of the 47 described *Periplaneta* species, and those available are rather brief and not completely accurate. Burmeister (1838), when establishing *Periplaneta* and describing *P. brunnea* as new, gave a brief and misleading description of a *P. americana* nymph. Brunner de Wattenwyl (1865), Rague (1965), and Harz and Kaltenbach (1976) described accurately but briefly the nymphs of *P. americana* and *P. australasiae*. Hebard (1917) gave brief descriptions of *P. americana*, *P. australasiae*, and *P. fuliginosa* nymphs. Sweetman (1965) provided key characters for early instar nymphs of *P. americana*, *P. australasiae*, *P. brunnea*, and *P. fuliginosa*. Wright (1973, 1979) provided short descriptions of *P. brunnea* and *P. fuliginosa*, respectively. Huber (1974) subjected to analysis by methods of numerical taxonomy the first- and last-instar nymphs of the four North American *Periplaneta* species. The nymphs of *P. japonica* have not been studied previously.

Accurate identification of first-instar nymphs of *P. americana*, *P. australasiae*, *P. brunnea*, *P. fuliginosa*, and *P. japonica* is important. These

five species are common and widespread pests and have the potential of being introduced into new areas. Chemical and cultural pest control measures could depend on quick and accurate identification of the pest species involved. Detailed descriptions and keys to the first-instar nymphs of these five *Periplaneta* species are presented here.

The description of each of the five species includes an adult diagnosis, a diagnosis of the first-instar nymph, a detailed description of the first-instar nymph, a brief statement of the distribution of the species, and a list of the material examined. Measurement ratios and setal numbers have been reported as a range followed by $\bar{x} + SD$, hence 64–84 (71.4 ± 5.5).

Since the key relies primarily on setal types, numbers, and patterns which are difficult to observe on unmounted specimens, it is necessary to clear and mount specimens on slides after the general body color has been determined. The pictorial key is primarily designed for use with whole, unmounted specimens.

Specimens of each of the five species were obtained from laboratory colonies maintained at the Cockroach Genetic Stock Center at Virginia Polytechnic Institute and State University (VPI and SU). Some of the *P. americana* were obtained from a laboratory colony of adult females collected in Roanoke, Virginia.

Unhatched oothecae were removed from laboratory rearing containers and placed in petri dishes which contained 2×3 cm pieces of moist plastic sponge. When the first-instars had tanned fully, they were killed and preserved in 70% ethanol to which a small amount of glycerin was added. Observations made on live nymphs, freshly preserved nymphs, and nymphs that had been preserved for six months or more showed that storage in ethanol did not affect the color to a noticeable degree. Specimens used for study with the scanning electron microscope were first preserved in formalin for 24 hours, then placed in 30% ethanol for 24 hours, and finally stored in 70% ethanol.

Specimens were cleared in cold potassium hydroxide overnight and mounted in glycerin on microscope slides. Adult and nymphal specimens were studied with the aid of a stereoscopic microscope with magnifications of 15 to $90\times$. A compound microscope with magnifications of 40 to $800\times$ was used for accurate counting and placement of setae. Setae on the pronotum were counted with the aid of an ocular grid. Measurements were made with an ocular micrometer. Figures of the thoracic regions of the five species were each drawn from a single specimen by use of an ocular drawing grid.

A scanning electron microscope was used to examine certain setae more closely. Specimens of all five species were coated with a 60:40 mixture of gold-palladium and examined with an Advanced Metals Research Scanning Electron Microscope (Model 900-52) equipped with EDAX (Model 707A).

NOTAL SETAE OF FIRST-INSTAR NYMPHS

Examination of the pro-, meso- and metanota of the first-instar nymph revealed the presence of six types of setae that can be divided into distinct groups. Information on the setae (Figs. 2-7) is presented below.

Setal Type	Length (mm)	Location
Long (LS)	0.13+	Primarily along the margins of the nota.
Moderately Long (MS)	0.06-0.12	Along and within the notal margins.
Short (SS)	0.02-0.05	Along and within the notal margins, but most common along the posterior margins.
Reclinate (RE)	0.01-0.02	Within the notal margins.
Chalazae (CA)	0.01-0.02	On the underside of the posterior notal margins.
Small (SM)	0.005-0.01	On the posterodorsal margins of the nota.

DISCUSSION

These five species of *Periplaneta* can be divided into two (natural) groups based on specific characters of the immature stages: number and length of nonmarginal notal setae, color pattern, and chromosome number.

Group I.—*P. americana* and *P. japonica*. Both are unicolorous, have short or moderately long, nonmarginal, notal setae, have short (7-10 mm) oothecae, and have a diploid chromosome number of 34 (Cohen and Roth, 1970).

Group II.—*P. brunnea*, *P. fuliginosa*, and *P. australasiae*. All three have banded color patterns, have moderately long to long, nonmarginal, notal setae, have long (11-14 mm) oothecae, and have a diploid chromosome number of 28.

Huber (1974) subjected characters of first-instar nymphs of *P. americana*, *P. australasiae*, *P. brunnea*, and *P. fuliginosa* (but not *P. japonica*) to numerical analysis. In his results, *P. fuliginosa*, *P. australasiae*, and *P. brunnea* formed a distinct group and *P. americana* was isolated from the other species. The research presented here supports that of Huber (1974), and places *P. japonica* close to *P. americana*.

KEY TO FIRST-INSTAR NYMPHS OF *PERIPLANETA AMERICANA*, *P. AUSTRALASIAE*,
P. BRUNNEA, *P. FULIGINOSA*, AND *P. JAPONICA*

1. Antenna, head, thorax, and abdomen unicolorous pale brown to dark brown; majority of nonmarginal setae on nota short and moderately long 2

PICTORIAL KEY TO FIRST-STAGE NYMPHS
OF FIVE PERIPLANETA SPECIES

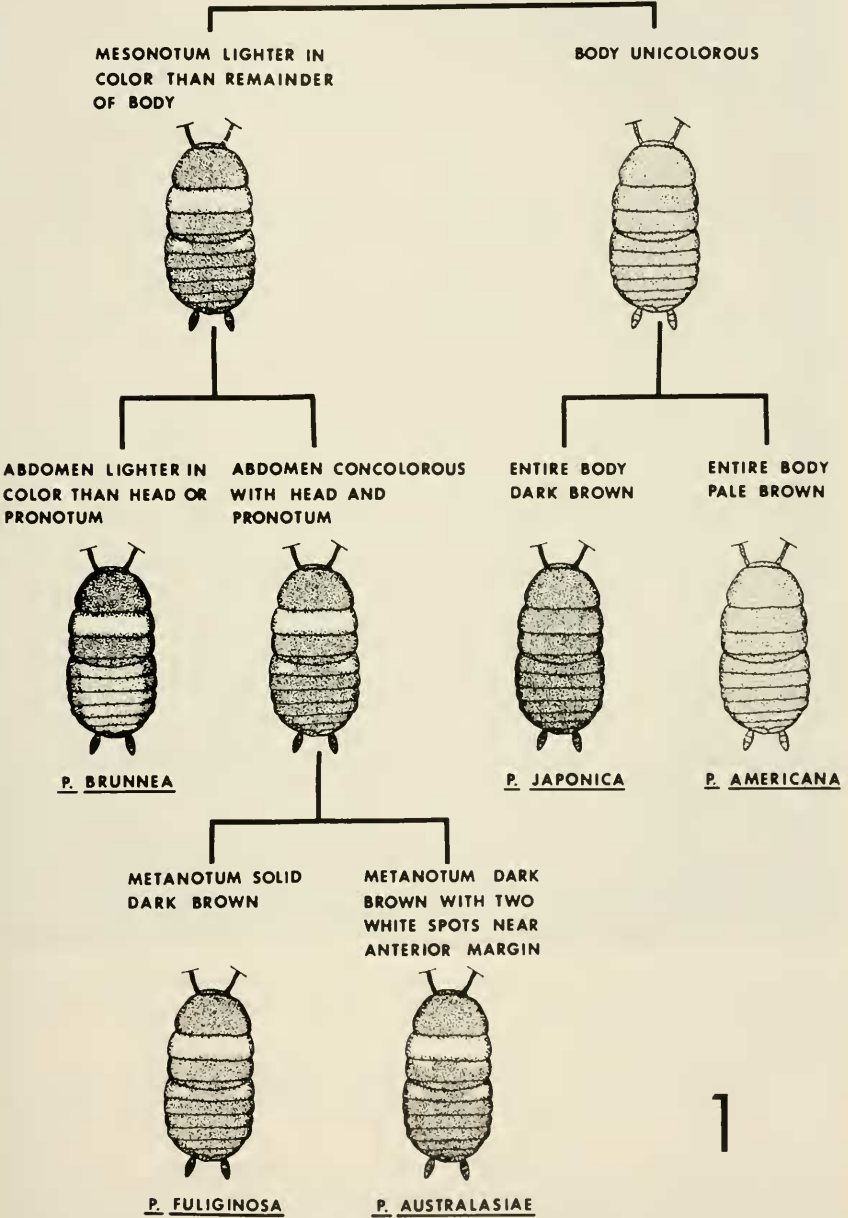


Fig. 1. Pictorial key to first-instar nymphs of five *Periplaneta* species.

- Antenna with 2 pale bands at basal and distal ends; mesonotum lighter in color than pronotum; majority of nonmarginal setae on nota moderately long, and long 3
- 2. Entire body dark brown; pronotum with 36-44 nonmarginal setae, mesonotum with 16-22 nonmarginal setae; metanotum with 12-16 nonmarginal setae *P. japonica* Karny
- Entire body pale brown; pronotum with 50-82 nonmarginal setae; mesonotum with 24-38 nonmarginal setae; metanotum with 22-32 nonmarginal setae *P. americana* (Linnaeus)
- 3. Abdominal dorsum lighter in color than head or pronotum; abdominal segments I and II ventromedially pale brown, dark brown laterally *P. brunnea* Burmeister
- Abdominal dorsum concolorous with head and pronotum; abdominal segments I and II entirely white ventrally 4
- 4. Metanotum dark brown; pronotum with 52-90 nonmarginal setae; mesonotum with 18-36 nonmarginal setae; metanotum with 16-24 nonmarginal setae *P. fuliginosa* (Serville)
- Metanotum dark brown with 2 white spots near anterior margin (rarely absent); pronotum with 102-122 nonmarginal setae; mesonotum with 35-56 nonmarginal setae; metanotum with 30-38 nonmarginal setae *P. australasiae* (Fabricius)

Periplaneta americana (Linnaeus)

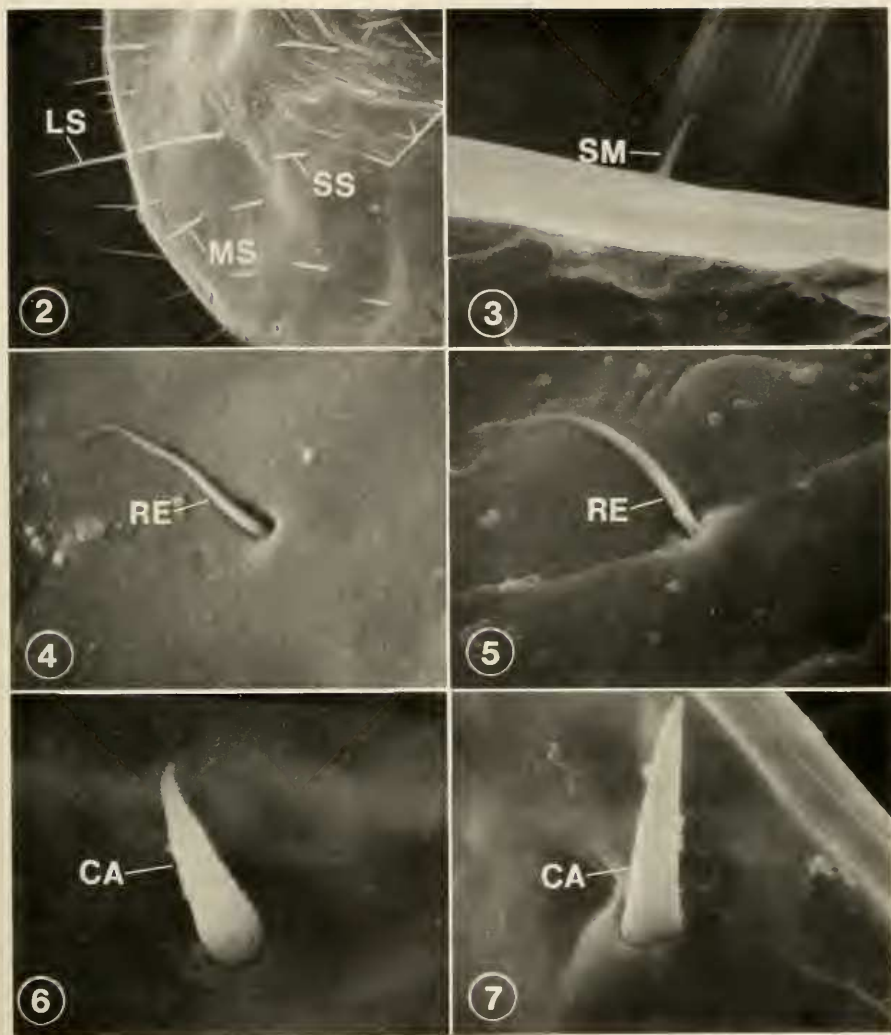
Fig. 8

Adult diagnosis.—Color above chestnut brown; tegmina unicolorous; last segment of male and female cercus twice as long as wide; male abdominal segment I unmodified; male supraanal plate translucent, apically rounded and deeply notched, produced considerably beyond the subgenital plate.

First-instar nymph diagnosis.—Antenna, head, thorax, and abdomen unicolorous pale brown; majority of nonmarginal setae on nota short and moderately long; pronotum with 50-82 nonmarginal setae; mesonotum with 24-38 nonmarginal setae; metanotum with 22-32 nonmarginal setae.

First-instar nymph description (N = 10).—Head pale brown dorsally and ventrally; ocelliform spot distinct, white; apical tips of maxillary and labial palps white; interocular ratio 1.92-2.34 (2.03 ± 0.12). Antenna as long as body, pale brown.

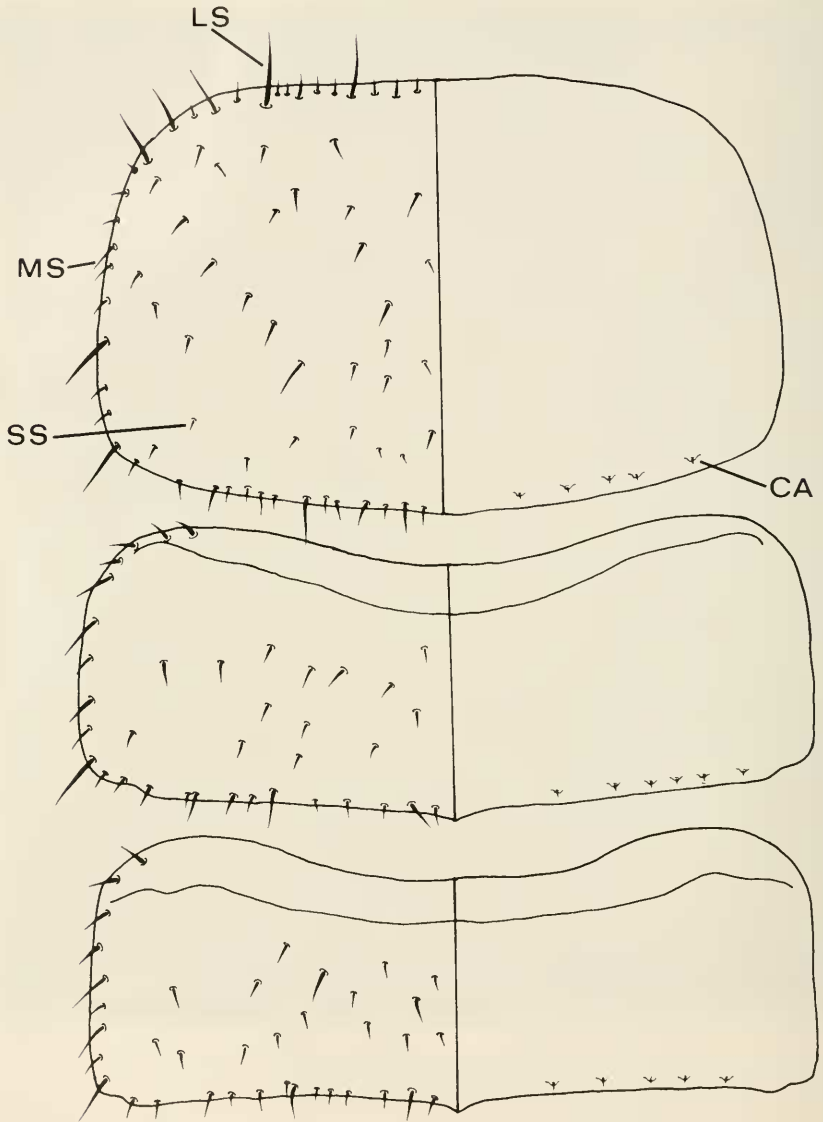
Thoracic nota pale brown, sparsely setose. Majority of nonmarginal setae short and moderately long. *Pronotum*: Length-width ratio 0.66-0.72 (0.70 ± 0.02); 64-84 (71.4 ± 5.5) marginal setae; 50-82 (64.8 ± 8.4) nonmarginal setae; 10-14 (10.4 ± 1.3) chalazae, on underside of posterior margin. *Mesonotum*: 38-52 (45.0 ± 4.1) marginal setae; 24-38 (33.2 ± 4.1) nonmarginal setae; 10-12 (10.4 ± 0.8) chalazae. *Metanotum*: 38-48 (43.6 ± 3.0) marginal setae; 22-32 (25.8 ± 3.1) nonmarginal setae; 10-12 (10.4 ± 0.8) chalazae.



Figs. 2-7. First-instar notal setae. 2, *P. australasiae*, anterior right margin of pronotum (200 \times). 3, *P. fuliginosa*, posterior margin of metanotum (5000 \times). 4, *P. australasiae*, pronotum (5000 \times). 5, *P. fuliginosa*, pronotum (5000 \times). 6, *P. australasiae*, pronotum (5000 \times). 7, *P. fuliginosa*, mesonotum (5000 \times). CA = chalaza; LS = long seta; MS = moderately long seta; RE = reclinate seta; SM = small seta; SS = short seta.

Abdominal terga pale brown, sparsely setose, segments II-VIII dorsally with a strong seta at posterolateral corner. Segments I-VIII pale brown ventrally, glabrous. Cercus pale brown, 3-segmented.

Legs pale brown to white. Coxae with scattered small setae. Tarsi slightly



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Fig. 8. *P. americana*, first-instar thoracic nota; dorsal view (left half) showing setae (except reclinate, small, and chalaza); ventral view (right half) showing chalaza. CA = chalaza; LS = long seta; MS = moderately long seta; SS = short seta.

longer than tibiae, each tarsomere with 3 strong setae ventrally. *Foreleg*: Femur with curved row of 15–19 (17.1 ± 1.3) stout setae on anteroventral margin, apical seta $\frac{1}{7}$ length of femur; tibia with 8–10 (9.3 ± 0.7) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Midleg*: Femur with curved row of 9 stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 12–15 (13.6 ± 1.0) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Hindleg*: Femur with curved row of 9 stout setae on anteroventral margin, apical seta $\frac{1}{6}$ length of femur; tibia with 19–24 (22.5 ± 1.6) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{5}$ length of tibia.

Known distribution.—Africa, Europe, India, Japan, Australia, North America, South America.

Material examined.—Five first-instar nymphs from the Cockroach Genetic Stock Center at VPI and SU, 1 from each of the following hatch dates: April 24, 1978; June 29, 1978; July 23, 1978; August 3, 1978; August 6, 1978; and 5 first-instar nymphs from the Roanoke, Virginia colony, 1 from each of the following hatch dates: February 28, 1978; March 27, 1978; April 7, 1978; May 27, 1978; June 6, 1978.

Periplaneta japonica Karny

Fig. 9

Adult diagnosis.—Color above entirely blackish brown; female brachypterous; male abdominal segment I with broad, shallow depression bearing tuft of setae; male supraanal plate sclerotized, opaque, not or scarcely produced beyond the subgenital plate, with parallel sides and an acute emargination of the posterior margin, lateral angles acute and projecting in the form of sharp spines; ventral surface of male supraanal plate not specialized.

First-instar nymph diagnosis.—Antenna, head, thorax, and abdomen unicolorous dark brown; majority of nonmarginal setae on nota short and moderately long; pronotum with 36–44 nonmarginal setae; mesonotum with 16–22 nonmarginal setae; metanotum with 12–16 nonmarginal setae.

First-instar nymph description (N = 10).—Head dark brown dorsally and ventrally; ocelliform spot distinct, pale brown; apical tips of maxillary and labial palps white; interocular ratio 1.85–2.03 (1.94 ± 0.06). Antenna as long as body, dark brown.

Thoracic nota dark brown medially, pale brown laterally, sparsely setose. Majority of nonmarginal setae short and moderately long. *Pronotum*: Length-width ratio 0.59–0.68 (0.63 ± 0.03); 60–76 (68.4 ± 5.2) marginal setae; 36–44 (39.2 ± 2.5) nonmarginal setae; 6–10 (8.0 ± 0.9) chalazae on underside of posterior margin. *Mesonotum*: 38–46 (41.0 ± 3.0) marginal setae; 16–22 (19.0 ± 1.7) nonmarginal setae; 8–10 (8.4 ± 0.8) chalazae. *Metanotum*: 36–44 (39.2 ± 2.9) marginal setae; 12–16 (13.8 ± 1.5) nonmarginal setae; 8–10 (8.8 ± 1.0) chalazae.

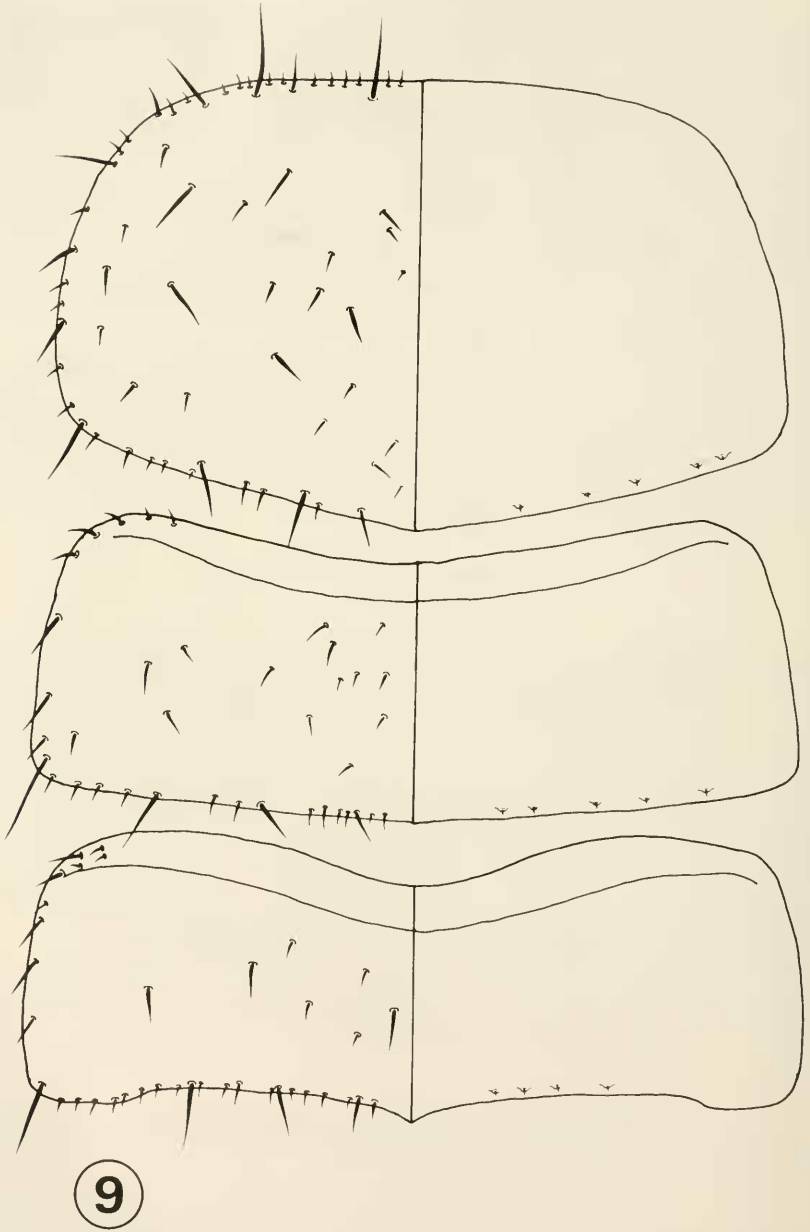


Fig. 9. *P. japonica*, first-instar thoracic nota; dorsal view (left half) showing setae (except reclinate, small, and chalaza); ventral view (right half) showing chalaza.

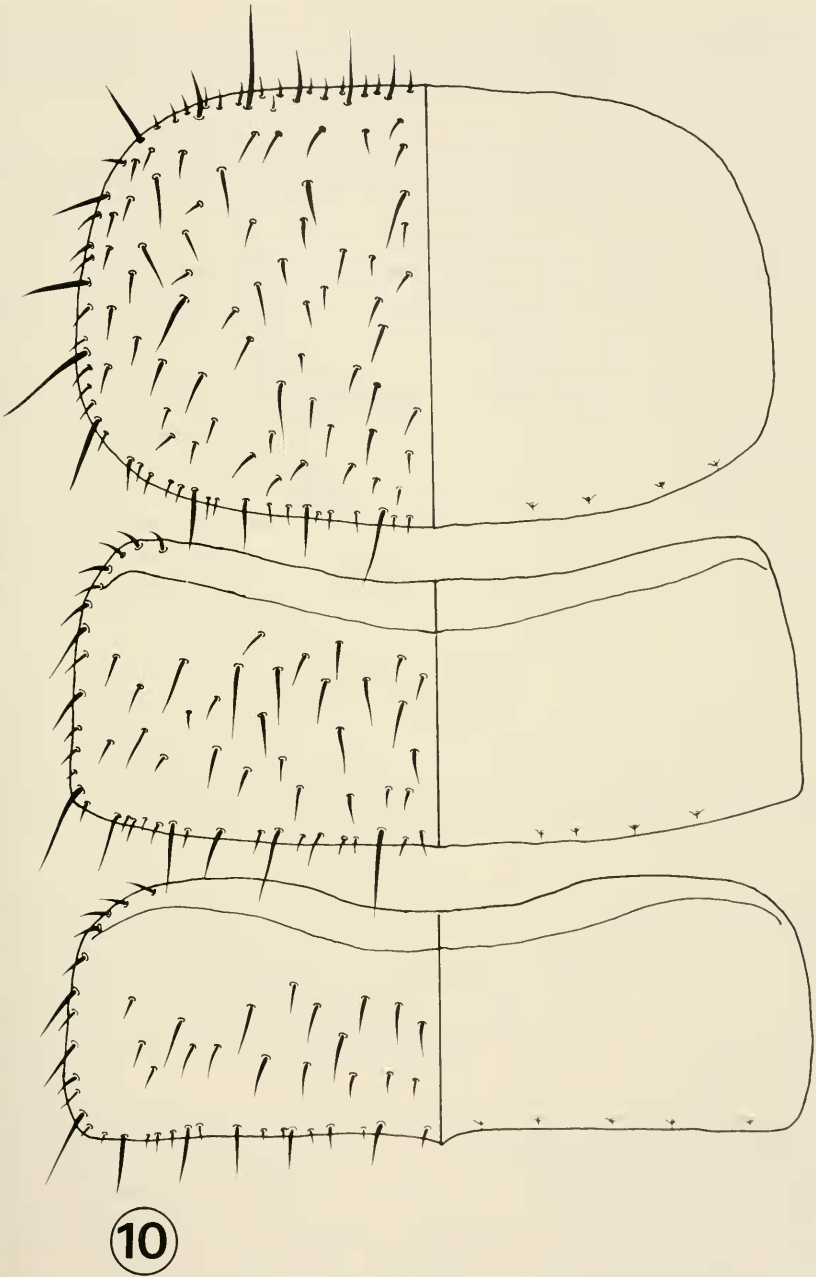


Fig. 10. *P. australasiae*, first-instar thoracic nota; dorsal view (left half) showing setae (except reclinate, small, and chalaza); ventral view (right half) showing chalaza.

Abdominal terga dark brown medially, pale brown laterally, sparsely setose, segments II–VIII dorsally with a strong seta at posterolateral corner. Segments I–VIII dark brown ventrally, glabrous. Cercus pale brown, 3-segmented.

Legs dark brown to brownish white. Coxae with scattered small setae. Tarsi slightly longer than tibiae, each tarsomere with 3 strong setae ventrally. *Foreleg*: Femur with curved row of 16–18 (17.1 ± 0.7) stout setae on anteroventral margin, apical seta $\frac{1}{2}$ length of femur; tibia with 7–10 (8.5 ± 1.0) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Midleg*: Femur with curved row of 9–10 (9.2 ± 0.4) stout setae on anteroventral margin, apical seta $\frac{1}{4}$ length of femur; tibia with 15–18 (16.1 ± 0.9) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Hindleg*: Femur with curved row of 9–10 (9.4 ± 0.5) stout setae on anteroventral margin, apical seta $\frac{1}{4}$ length of femur; tibia with 24–30 (26.8 ± 1.8) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{5}$ length of tibia.

Known distribution.—Japan, China, U.S.S.R.

Material examined.—Ten first-instar nymphs from the Cockroach Genetic Stock Center at VPI and SU: 2 from the June 16, 1978 hatch date, 5 from the July 15, 1978 hatch date, and 3 from the July 23, 1978 hatch date.

Periplaneta australasiae (Fabricius)

Figs. 2, 4, 6, 10

Adult diagnosis.—Color above chestnut brown; tegmina with yellow submarginal stripe along basal $\frac{1}{3}$; male abdominal segment I with broad, shallow median depression bearing tuft of setae; male supraanal plate sclerotized, opaque, apically truncate and not deeply notched, not or scarcely produced beyond the subgenital plate, ventral surface of male supraanal plate not specialized.

First-instar nymph diagnosis.—Antenna with 2 pale bands at basal and distal ends; mesonotum lighter in color than pronotum; metanotum dark brown with 2 white spots near anterior margin (rarely absent); abdominal segments I and II white ventrally; majority of nonmarginal setae on nota moderately long and long; pronotum with 102–122 nonmarginal setae; mesonotum with 36–56 nonmarginal setae; metanotum with 30–38 nonmarginal setae.

First-instar nymph description (N = 10).—Head dark brown dorsally and ventrally; ocelliform spot distinct, pale brown, apical tips of maxillary and labial palps white; interocular ratio 1.91–2.32 (2.02 ± 0.13). Antenna as long as body, first 5–6 segments all or partly pale brown, last 4–5 segments pale brown to white, intermediate segments dark brown.

Thoracic nota dark brown to brownish white, setose. Majority of nonmarginal setae moderately long, and long. *Pronotum*: Dark brown; length-width ratio 0.66–0.72 (0.69 ± 0.02); 90–102 (96.0 ± 3.9) marginal setae; 102–

122 (112.6 ± 7.3) nonmarginal setae; 8 chalazae on underside of posterior margin. *Mesonotum*: White, translucent medially, bordered anteriorly and posteriorly by dark brown bands; 48–58 (53.0 ± 3.0) marginal setae; 36–56 (46.8 ± 5.4) nonmarginal setae; 6–10 (8.0 ± 1.3) chalazae. *Metanotum*: Dark brown medially, pale brown laterally, with 2 pale brown to white spots near anterior margin; 46–56 (49.8 ± 2.7) marginal setae; 30–38 (33.8 ± 2.4) nonmarginal setae; 6–10 (8.0 ± 0.9) chalazae on underside of posterior margin.

Abdominal terga dark brown, setose, segment II dark brown medially, white laterally, segments II–VIII dorsally with a strong seta at posterolateral corner. Segments I and II white ventrally, segments III–VIII dark brown ventrally, glabrous. Cerci dark brown, 3-segmented.

Legs dark brown to brownish white. Coxae with scattered small setae. Tarsi slightly longer than tibiae, each tarsomere with 3 strong setae ventrally. *Foreleg*: Femur with curved row of 14–17 (15.4 ± 0.8) stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 9–11 (10.1 ± 0.6) strong setae on apical $\frac{2}{3}$, apical seta $\frac{1}{3}$ length of tibia. *Midleg*: Femur with curved row of 9 stout setae on anteroventral margin, apical seta $\frac{1}{4}$ length of femur; tibia with 15–17 (15.6 ± 0.7) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Hindleg*: Femur with curved row of 9 stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 21–23 (22.0 ± 0.8) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{4}$ length tibia.

Known distribution.—Africa, Australia, Europe, Japan, North America, South America, West Indies.

Material examined.—Ten first-instar nymphs from the Cockroach Genetic Stock Center at VPI and SU, 1 from each of the following hatch dates: November 15, 1977; March 8, 1978; April 1, 1978; April 12, 1978; April 20, 1978; April 26, 1978; May 9, 1978; May 17, 1978; May 19, 1978; June 7, 1978.

Remarks.—Approximately 5–6% of 147 specimens did not have two white spots on the mesonotum. Nine of the ten specimens used for the description had two spots; the tenth specimen had only one spot.

Periplaneta brunnea Burmeister

Fig. 11

Adult diagnosis.—Color above chestnut brown; tegmina unicolorous; last segment of male and female cercus not twice as long as wide; male abdominal segment I with broad, shallow median depression bearing tuft of setae; male supraanal plate sclerotized, opaque, apically truncate and not deeply notched, not or scarcely produced beyond the subgenital plate; ventral surface of male supraanal plate not specialized.

First-instar nymph diagnosis.—Antenna with 2 pale bands at basal and distal ends; mesonotum lighter in color than pronotum; abdominal dorsum lighter in color than head or pronotum; abdominal segments I and II ven-

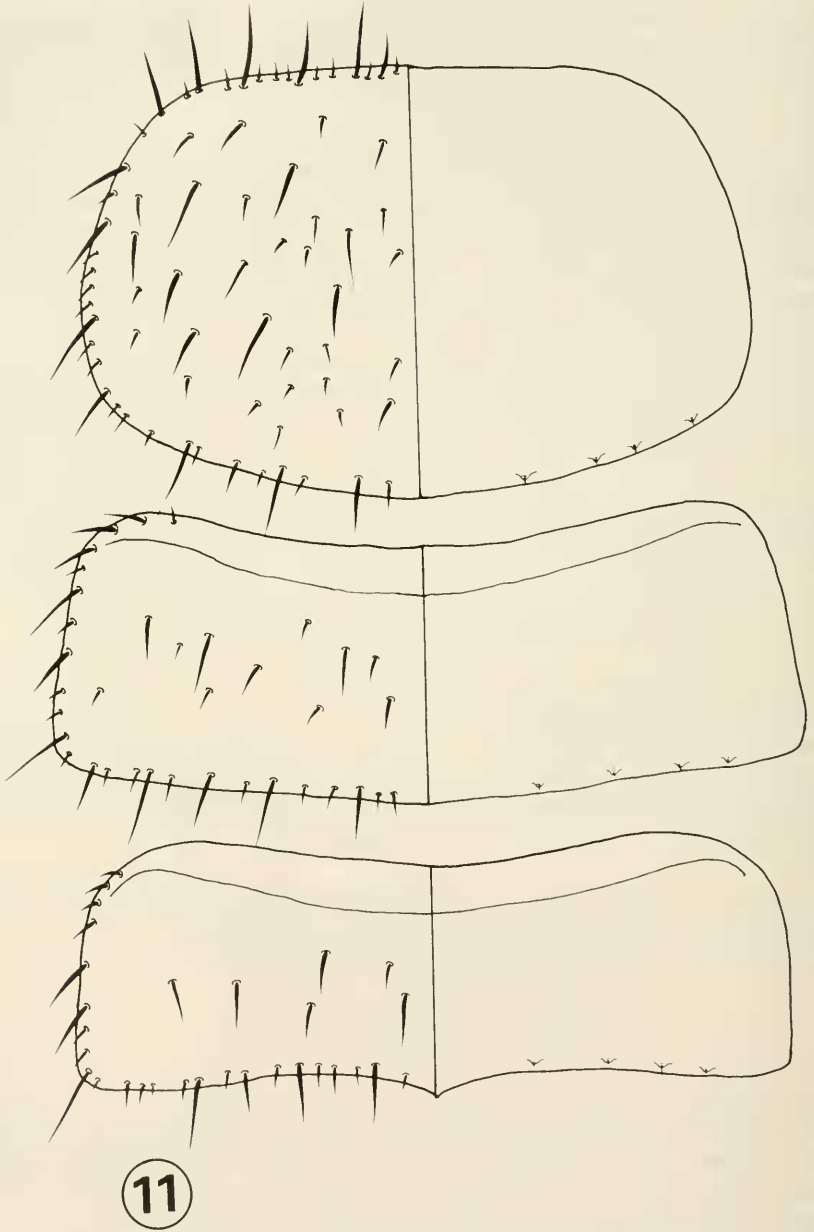


Fig. 11. *P. brunnea*, first-instar thoracic nota; dorsal view (left half) showing setae (except reclinate, small, and chalaza); ventral view (right half) showing chalaza.

tromedially pale brown, dark brown laterally; majority of nonmarginal setae on nota moderately long and long.

First-instar nymph description (N = 10).—Head dark brown dorsally, pale brown ventrally; ocelliform spot distinct, pale brown; apical tips of maxillary and labial palps white; interocular ratio 1.75–1.97 (1.89 ± 0.07). Antenna as long as body, first 8–9 segments pale brown, last 5–6 segments white, intermediate segments brown.

Thoracic nota brown to brownish white setose. Majority of nonmarginal setae moderately long and long. *Pronotum*: Dark brown medially, pale brown laterally; length-width ratio 0.65–0.72 (0.67 ± 0.03 ; 80–98 (86.6 ± 5.4) marginal setae; 60–72 (65.8 ± 5.1) nonmarginal setae; 8 (8.0 ± 0.0) chazalae. *Mesonotum*: Pale brown to whitish-brown, translucent medially, bordered anteriorly and posteriorly by brown bands; 48–60 (52.6 ± 3.8) marginal setae; 22–30 (23.8 ± 2.6) nonmarginal setae; 8 (8.0 ± 0.0) chazalae. *Metanotum*: Dark brown medially, pale brown laterally; 44–54 (49.4 ± 3.7) marginal setae; 16–24 (19.2 ± 2.9) nonmarginal setae; 6–8 (7.8 ± 0.6) chazalae.

Abdominal terga pale brown medially, brown laterally, setose, segments I and II dorsally entirely pale brown, segments II–VIII dorsally with a strong seta at posteriolateral corner. Segments I–VIII ventrally pale brown medially, dark brown laterally, glabrous. Cercus dark brown, 3-segmented.

Legs brown to brownish white. Coxae with scattered small setae. Tarsi slightly longer than tibiae, each tarsomere with 3 strong setae ventrally. *Foreleg*: Femur with curved row of 17–19 (18.1 ± 0.6) stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 8–11 (9.6 ± 1.1) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Midleg*: Femur with curved row of 9–10 (9.2 ± 0.4) stout setae on anteroventral margin, apical seta $\frac{1}{4}$ length of femur; tibia with 14–17 (15.9 ± 1.0) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Hindleg*: Femur with curved row of 9 (9.0 ± 0.0) stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 21–26 (23.2 ± 1.5) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{5}$ length of tibia.

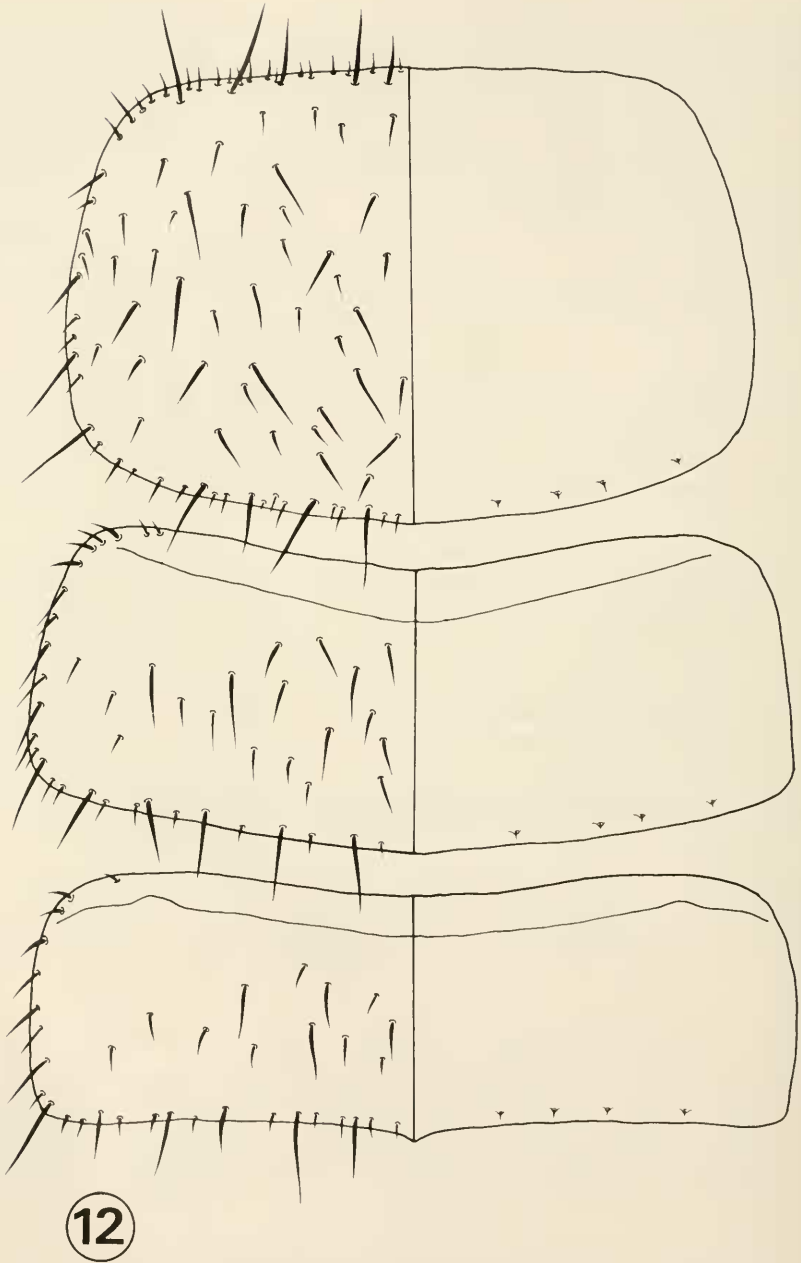
Known distribution.—Africa, Australia, South China, Malaysia, Japan, North America, South America.

Material examined.—Ten first-instar nymphs from the Cockroach Genetic Stock Center at VPI and SU, 2 from March 8, 1978 hatch date and 1 from each of the following hatch dates: November 8, 1977; May 15, 1978; May 17, 1978; May 30, 1978; June 4, 1978; June 15, 1978; June 18, 1978; June 20, 1978.

Periplaneta fuliginosa (Serville)

Figs. 3, 5, 7, 12

Adult diagnosis.—Color above entirely blackish brown; both sexes fully



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Fig. 12. *P. fuliginosa*, first-instar thoracic nota; dorsal view (left half) showing setae (except reclinate, small, and chalaza); ventral view (right half) showing chalaza.

winged; male abdominal segment I with broad, shallow depression bearing tuft of setae; male supraanal plate sclerotized, opaque, apically truncate and not deeply notched, not or scarcely produced beyond the subgenital plate; ventral surface of male supraanal plate specialized bearing two large callosities, the surfaces of which are covered with microscopic denticulations.

First-instar nymph diagnosis.—Antenna with 2 pale bands at basal and distal ends; mesonotum lighter in color than pronotum; metanotum solid dark brown; abdominal segments I and II white ventrally; majority of nonmarginal setae on nota moderately long and long; pronotum with 52–90 nonmarginal setae; mesonotum with 18–36 nonmarginal setae; metanotum with 16–24 nonmarginal setae.

First-instar nymph description (N = 10).—Head dark brown dorsally and ventrally; ocelliform spot distinct, pale brown; apical tips of maxillary and labial palps white; interocular ratio 1.79–2.09 (1.96 ± 0.08). Antenna as long as body, first 3–6 segments all or partly pale brown, last 4–5 segments pale brown to white, intermediate segments dark brown.

Thoracic nota dark brown to brownish white, setose, Majority of nonmarginal setae moderately long and long. *Pronotum*: Dark brown; length-width ratio 0.62–0.69 (0.65 ± 0.02); 78–96 (87.6 ± 5.7) marginal setae; 52–90 (75.8 ± 11.2) nonmarginal setae; 6–8 (7.6 ± 0.8) chalazae. *Mesonotum*: Pale brown to white, translucent medially, bordered anteriorly and posteriorly by dark brown bands; 40–56 (49.6 ± 5.2) marginal setae; 18–36 (29.8 ± 5.5) nonmarginal setae; 4–8 (7.2 ± 1.4) chalazae. *Metanotum*: Dark brown medially, pale brown laterally; 40–52 (47.8 ± 3.7) marginal setae; 16–24 (22.0 ± 2.3) nonmarginal setae; 6–10 (8.0 ± 0.9) chalazae.

Abdominal terga dark brown, setose, segment II dark brown medially, white laterally, segments II–VIII dorsally with a strong seta at posterolateral corner. Segments I and II white ventrally, segments III–VIII dark brown ventrally, glabrous. Cercus dark brown, 3-segmented.

Legs dark brown to brownish white. Coxae with scattered small setae. Tarsi slightly longer than tibiae, each tarsomere with 3 strong setae ventrally. *Foreleg*: Femur with curved row of 16–19 (18.1 ± 0.9) stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 9–11 (9.6 ± 0.7) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Midleg*: Femur with curved row of 9–10 (9.1 ± 0.3) stout setae on anteroventral margin, apical seta $\frac{1}{4}$ length of femur; tibia with 13–17 (15.2 ± 1.4) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{3}$ length of tibia. *Hindleg*: Femur with curved row of 9– (9.2 ± 0.4) stout setae on anteroventral margin, apical seta $\frac{1}{5}$ length of femur; tibia with 23–27 (25.6 ± 1.2) strong setae on apical $\frac{2}{3}$, apical setae $\frac{1}{4}$ length of tibia.

Known distribution.—Japan, China, North America, South America.

Material examined.—Ten first-instar nymphs from the Cockroach Genetic

Stock Center at VPI and SU, 2 from the May 12, 1978 hatch date and 1 from each of the following hatch dates: November 18, 1977; February 7, 1978; May 30, 1978; June 4, 1978; June 11, 1978; June 14, 1978; December 4, 1978; December 8, 1978.

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